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Publication date:
2011

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Citation (APA):

Høj, M., Brorson, M., Jensen, A. D., & Grunwaldt, J-D. (2011). Flame synthesized CoMo/Al₂O₃ hydrotreating catalysts. Abstract from 8th European Congress of Chemical Engineering, Berlin, Germany.

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Flame synthesized CoMo/Al₂O₃ hydrotreating catalysts

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Introduction

Liquid fed flame spray pyrolysis (FSP) is a novel one-step synthesis method for nano-sized particles [1]. Organic metal precursors are dissolved in an organic solvent which is sprayed with high velocity oxygen and ignited with a small methane-oxygen flame. The collected flame product is non-porous nanoparticles [1], particularly interesting in catalysis. Here they are investigated as hydrotreating catalysts to remove sulphur and nitrogen from heterocyclic compounds in crude oil [2]. Industrial hydrotreating catalysts contain Co or Ni promoted MoS₂ as active phase, on an alumina support [2]. The transition metal sulphide phase has been obtained after sulfiding the directly by FSP prepared material [3].

Results

Seven CoMo/Al₂O₃ samples were synthesized by FSP. The catalysts had specific surface areas between 221 and 90 m²/g, with decreasing surface area with increasing transition metal content. This corresponds to average primary particle sizes of 7 to 13 nm, showing that nanoparticles were the flame product [3].

The activities of the catalysts for removal of heterocyclic sulphur and nitrogen were measured after sulfidation. The best catalysts contained 16 wt.% Mo (atomic ratio Co/Mo = 1/3). With approximately 75% of the activity of a commercial alumina supported CoMo catalyst this is strikingly good [3]. X-ray diffraction (XRD) and UV-vis reflectance spectroscopy revealed that the oxide precursor contained γ-Al₂O₃ with some CoAl₂O₄ spinel, while MoO₃ was XRD amorphous [3]. Experiments of suppressing the undesired CoAl₂O₄ spinel are presently under way.

References

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